Computer Simulations Of The Oxygen (O_2) Atmosphere Of Europa

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We have developed numerical gas-dynamic computer simulations of the molecular oxygen, 0_2, atmosphere of Europa and compare the results with the recent Hubble Space Telescope observations. In our model, we start with a H_20 ice frost after which sublimation caused by solar heating leads to the formation of a thin H_2O vapor atmosphere, Dissociation of H_20 by solar UV and association of the product oxygen atoms in three body reactions competing with UV dissociation of 0_2 lead to the formation of a molecular 0_2 atmosphere. We also include surface sputtering by torus plasma as a source of H_20 and 0_2. We use a surface temperature based on Voyager measurements, as well as a vapor pressure for H_20 and 0_2 based on laboratory experiments. We divide the atmospheric domain into a mesh of 10^5 computational cells and solve the equations of mass, energy momentum conservation and equation of state. We find the pressure, density, temperature and wind velocities as a function of altitude and colatitude angle from the subsolar point region. This model allows us to obtain the structure and dynamics of Europa's 0_2 atmosphere going from agreement with recent HST observations, to those features which have not been observed yet, such as wind velocity, temperature and details of atmospheric structure. We also propose that Europa has an H_2O, 0, $S0_2$, and Sodium atmosphere coexisting with 0_2. We base these arguments on HST and other observations of the reflection spectrum of its surface and on the Voyager in situ measurements of torus ions in the vicinity of Europa. We propose that sodium ions implanted on the surface are subsequently sublimated and also sputtered, forming a steady state thin sodium atmosphere imbedded in 0_2, 0 and $S0_2$ atmosphere. We focus on the detailed structure of the 0_2 atmosphere of Europa, but also present results from the H_20, $S0_2$ and Sodium simulations verifying the viability of these irnbedded species.

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10. Schedule paper together, before or after papers on the Hubble Space Telescope observations of Europa's 0_2 atmosphere.

11. No